

LISTING OF THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1.(Currently Amended) Optical metrology method for determining the three-dimensional topography of an orifice, in particular for the measurement of micrometric, tapered nozzles and other similar devices (13), using illuminated means (1) of the object to be analysed (14) and observation means (2) of the object to be analysed (14), which includes at least one camera (11), characterised in that it comprises an initial step for checking that the image plane (z) for said illumination means (1) coincides with the object plane for the observation means (2); the method further comprising the steps of:

- arranging the object to be analysed (14) on a microscope slide with the greater diameter opening facing the illumination means (1);
- centring one of the orifices (13) of the object to be analysed (14) in the field of view of the observation means (2);
- bringing into focus by means of wide-field illumination the smaller diameter opening of the orifice (13) to be analysed;
- measuring the diameter of the orifice as well as major defects such as the absence of an orifice or large-scale deformations;
- modifying the focus plane (z_i) of the inner part of the orifice (13) of the object (14) by changing it to another focus plane (z_{i+1});
- measuring the contour of the orifice (13) in the focus plane (z_{i+1}) in order to determine the inner topography of the orifice (13) by projecting a sequence of patterns and measuring the position of the points of the contour of the orifice (13) when the images of the projected pattern and their reflection on the inner walls of the orifice (13) are superimposed on the plane of the camera (11);
- repeating the above process for a number of planes ($z_i \dots z_n$) inside the orifice (13);
- processing the data for the contours measured in the different planes to obtain a three-dimensional geometrical representation of the inner topography of the orifice (13), as well as its characteristic parameters (maximum and minimum diameters of the orifice (13), slope of the wall of the orifice (13), deviations from nominal figure, position of the axis of the orifice (13), etc.).

2. (Currently Amended) Method as claimed in claim 1, characterized in that wherein said sequence of patterns are circular patterns of a given, increasing radius.

3. (Currently Amended) Method as claimed in claim 1, characterized in that wherein the points of the contour on the focus plane (z_i) are measured using a cylindrical coordinate system with a resolution of 360-720 points measured along the length of the contour of the orifice (13).

4. (Currently Amended) Method as claimed in claim 1, characterized in that wherein a series of images ranging from 10 to 25 in number is acquired in order to obtain the points measured along the contour of the orifice (13).

5. (Currently Amended) Method is claimed in claim 1, characterized in that wherein the spacing between focus planes (z_i) ranges from 1 to 10 μm .

6. (Currently Amended) Method as claimed in claim 1, characterized in that wherein the step of modifying the focus plane (z_i) of the object being analysed (14) by another focus plane (z_{i+1}) is repeated by a given number of times to obtain values in just as many focus planes (z_n) within the orifice (13) of the object (14), depending on the thickness of the object being analysed and the requirements of the analysis parameters.

7. (Currently Amended) Apparatus for determining three-dimensional topographies according to the method as claimed in ~~any of the preceding claims~~ claim 1, wherein and in particular for measuring micrometric tapered nozzles and other, similar devices (13), the apparatus being characterized in that it comprises illumination means (1), observation means (2) and computer processing means (3), said illumination means (1) comprising a microscope objective (4) associated with said illumination means (1), a light source (5), a pattern representation system (6), an optical system (8) associated with the illumination means (1); and said observation means (2) comprising a microscope objective (9) associated with the observation means (2), an optical system (10) associated with the observation means (2), and at least one camera (11, 18).

8. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein it includes a mirror (7) that deviates the light emitted from said light source at a certain angle (5) towards said optical system (8).

9. (Currently Amended) Apparatus as claimed in claim 8, characterized in that wherein the angle of deviation of the light caused by the mirror (7) is 90°.

10. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein the objective (4) associated with the illumination means (1) is an 100X magnification SLWD objective (super-long working distance), whereas the objective (9) associated with the observation means (2) is a 50X magnification SLWD objective (super-long working distance), said camera (11) being a 1/3" camera.

11. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein said pattern representation system (6) is controlled by a computer (12) that forms part of said computer processing means (3) and allows to both visualise a wide-field illumination and to generate circular patterns of different diameters, said patterns being projected by means of said objective (4) with said optical system (8) inside the orifice (13) of the object being analysed (14).

12. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein said pattern representation system is a liquid crystal microdisplay (LCD) (6).

13. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein said pattern representation system is a liquid-crystal-on-silicon (LCOS) microdisplay (16), and also includes a light beam splitter (17).

14. (Currently Amended) Apparatus as claimed in claim 7, characterized in that wherein said light source (5) emits a broadband spectrum of light.

15. (Currently Amended) Apparatus as claimed in claim 7, ~~characterized in that~~ wherein said light source (5) is a laser and the pattern on the inner surface of the orifice is generated using a scanner.

16. (Currently Amended) Apparatus as claimed in claim 7, ~~characterized in that~~ wherein it includes an additional camera 918), said apparatus further including a light beam splitter (17).

17. (Currently Amended) Apparatus as claimed in claim 7, ~~characterized in that~~ wherein said camera or cameras (11,18) are CCD cameras.

18. (Currently Amended) Apparatus as claimed in claim 7, ~~characterized in that~~ wherein said camera or cameras (11,18) are CMOS cameras.